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AUTHOR Rubba, Peter A.
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ABSTRACT

A methodological weakness of recent studies on teacher shortages is the degree to which respondents in these surveys were removed from the school environment, and consequently from science and mathematics teacher hiring. An attempt was made to resolve this problem by assessing Illinois public school principals (grades 6 to 12) on science and mathematics teacher demand in their schools. A questionnaire (designed specifically for this purpose) was used to ask principals (N=413) to predict their schools' future demand for science and mathematics teachers given their knowledge of local population trends, and anticipated teacher retirement and resignations. Questionnaires were returned by 228 principals, a 55 percent return rate. This paper reports findings collected from 32 southern Illinois principals relative to the anticipated level of science teacher demand in southern Illinois through the 1985-86 to 1990-91 school years. Projections for 1985-86 indicate a need for 10 full time junior high school teachers, 10 quarter-time physics teachers, and 10 quarter time earth science/geology teachers; an adequate supply of chemistry teachers; and an oversupply of biology teachers. Projections for 1990-91 show essentially no demand for science teachers in southern Illinois. (JN)

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PUBLIC SCHOOL PRINCIPALS ASSESS ILLINOIS SCIENCE TEACHER DEMAND-- DATA FROM SOUTHERN ILLINOIS*

Peter A. Rubba, Ed.D.
Curriculum, Instruction and Media
Southern Illinois University
Carbondale, IL 62901

Akin (1982, 1983, 1984), Gerlovich and Howe (1983) and Shymansky and Aldridge (1982) are among the studies commonly cited to support the so called teacher shortages in science and mathematics. The 1981 through 1983 annual surveys of college and university placement personnel completed by Akin describe mathematics and physics as areas where a "considerable teacher shortage" exists. Chemistry, biology, earth science and general science are characterized as areas having "slight teacher shortages."

Gerlovich and Howe (1983) surveyed state level supervisors in 1980, 1981 and 1982 to gather perceptions of science and mathematics teacher demand. On average, across those three years, chemistry, earth science, mathematics and physics teachers were rated as being in short supply. Biology and general science teachers were perceived as being in adequate supply.

Shymansky and Aldridge (1982) reported 79 and 64 per cent respective declines in the numbers of newly certified science and

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mathematics teachers who accepted teaching positions between 1971 and 1980. Also, they reported a 4 per cent exodus-from-teaching rate (beyond a 1 per cent retirement rate) for science and mathematics teachers, and that half of all newly-employed science and mathematics teachers for the 1981-82 school year were "unqualified" to teach science or mathematics.

Looking particularly at Illinois, the ISBE supervisor(s) (anonymous) contacted by Gerlovich and Howe (1983) estimated chemistry, mathematics and physics to be areas of critical teacher shortages. Earth science and general science were described as areas with shortages, with biology noted as an area where an adequate supply of teachers existed. However, those assessments are not consistent with Illinois State Board of Education (ISBE) reports (Naumer & Gill, 1983a; 1983b). The summary section of "The supply and Demand for Illinois Mathematics and Science Teachers" (Naumer & Gill, 1983a) reads:

> In summary, there is a teacher shortage in mathematics and science in Illinois. The shortage can be described as moderate. The turnover rates for mathematics and science teachers are lower than the average turnover rate for all other teachers. Of those mathematics teachers who leave, approximately one-fifth resign to take different employment. Data do not show that physics, chemistry or higher level math teachers leave teaching at a greater rate than other science or math teachers. Furthermore, information obtained from Illinois public school districts does not support the belief that there are many vacant math and science teaching positions. Last, the quality of staff used to fill math and science positions is not known, but it can be assumed that persons hired have valid teaching certificates. (p. 5)

National studies, such as those completed by Akin, Gerlovich and Howe, and Shymansky and Aldridge, show severe teacher shortages across the U.S. in science and mathematics--a "crisis"

situation. ISBE data stand in sharp contrast to the finding of these studies. Given regional differences and the mobility of our population it may well be the case that the science and/or mathematics teacher shortage is not equally distributed across the U.S. In addition, none of the studies or reports cited above provide sufficient information for one to predict with confidence the status of science and mathematics teacher demand in Illinois, e.g., over the rest of this decade. Thus, the need arises to collect data relevant to future science and mathematics teachers demand in Illinois.

A methodological weakness of the studies completed by Akin, Gerlovich and Howe and Shymanky and Aldridge is the degree to which respondents in these surveys were removed from the secondary school environment, and so, science and mathematics teacher hiring. In this study an attempt was made to overcome this problem by assessing Illinois secondary school (grade 6-12) principals on science and mathematics teachers demand in their schools. A questionnaire was designed specifically for that purpose. In it, the secondary school principals were asked to predict their schools' future demand for science and mathematics teachers given their knowledge of local population trends, and anticipated teacher retirements and resignations. During its development the questionnaire was critiqued and validated by a panel composed of a science educator, a mathematics educator (neither of which were the researchers), two former secondary school principals (now college educators) and an active school principal.

In mid-April of 1983 the questionnaire on science and

mathematics teacher demand was sent to 413 Illinois public school principals. The 413 principals composed a 25 per cent ramdomly stratified (by ISBE Region) sample of the 1657 principals of public schools in Illinois which contained grades 6 and above. A letter of explanation, and a pre-addressed and stamped envelope accompanied the questionnaire. In the letter, the principals were asked to return the completed questionnaire by a specified date in early May. On or about that date each of the principals received a postcard on which was a reminder for them to complete and return the questionnaire.

Two hundred twenty-eight (228) principals, 55 per cent of the sample, returned usable questionnaires.<1> Descriptive statistics calculated on the percentage of questionnaire returns across the 57 ISBE regions showed the returns to be normally distributed across the regions (i.e., mean = 52.99%, median = 55.55% mode = 66.66%, standard deviation = 23.27%, minimum = 12.50% with $n = 1$, maximum = 100.00% with $n = 3$, skewness = symmetrical, kurtosis = mesokurtic)--these statistics were interpreted as evidence of the representativeness of the returns.

<1> The population contained an unknown number of principals from schools in which grades 6 thru 8 are not departmentalized. Such schools do not have "science" or "mathematics" teachers, per se. The principals of these schools should not have been in the population, or sample; however, the researchers had no means to identify them prior to the survey. Principals of four such schools returned the questionnaire (these were declared unusable). There were most probably others in the sample who did not return the questionnaire. Thus, the actual return rate may be higher.

This paper reports findings collected from those principals who returned the questionnaire and who were from schools in southern Illinois. Southern Illinois is defined as the lower 34 counties of Illinois, those south of a line created by, and including, the counties of Madison, Bond, Fayette, Effingham, Jasper and Crawford. The area is divided into 15 ISBE Regions.

Thirty-two (32) principals from this area returned questionnaires; 12 were from grade schools (grades k-8), 9 from high schools, 4 from unit schools (grades k-12), 3 from junior-senior high schools, 3 from junior high schools, and 1 from a middle school (grades 4-8). Table 1 shows the distribution of the 32 principals across the 15 ISBE Regions, as well as the number of principals who were in the sample and population, and the percentage of questionnaires returned within each of the regions.

Place Table 1 and 2 about here

For the purposes of this paper, the data collected from the 32 principals were analyzed relative to the following questions.

1. What is the anticipated level of science teacher demand in southern Illinois through the 1985-86 school year?
2. What is the anticipated level of science teacher demand in southern Illinois through the 1990-91 school year?

The net numbers of full-time and part-time junior high school science, general science, biology, chemistry and physics teachers needed through 1985-86, as reported by the 32 southern Illinois school principals, are presented in Table 3. Table 4 contains

similar data through 1990-91. The values in those tables were calculated from data presented by the principals in response to two affiliated questionnaire items per science teaching area. One item asked the principals to estimate the number of teachers in a science teaching area (e.g., junior high school science) which they would need to hire through the start of a particular school year (e.g., 1985-86). The other item asked the principals to estimate the number of teachers in that science teaching area whom they would need to release through the start of that same school year. The principals responded to the items by entering whole and/or decimal numbers (the latter to signify part of a full-time teacher). The principals were asked to take into consideration district population trends, local teacher attrition rates and expected teacher retirements. As the statistics in Table 2 reveal, data the principals provided on school population shows the overall population of the 32 schools will remain at about present levels through 1990-91.

The net full-time (100%) and part-time (i.e., 25%, 50%, 75%) science teacher positions presented in Tables 3 and 4 were calculated by taking the difference between the total numbers of science teachers the 32 southern Illinois principals reported they needed to hire and release. Thus, positive values signify the net number of science teachers the principals reported needed to be hired; negative values signify the net number of science teachers needed to be released by sample members; zeros signify situations where the number of science teachers needed to be hired equaled the number they needed to be released; blanks indicate no data were reported by the principals.

Place Tables 3 and 4 about here

Assuming the returns from the 32 southern Illinois principals were representative (argument provided above), and given the 32 returns are approximately equivalent to 10 percent of the principals in the southern Illinois area (see Table 1), a ROUGH estimate of the number of science teachers demand in southern Illinois through 1985-86 and 1990-91 can be obtained by multiplying the values in Tables 3 and 4, respectively, by a coefficient of 10. When this is done one gets the projected science teacher demand for southern Illinois which are presented in parentheses in Tables 3 and 4.

It would appear from the projections in Table 3 there will exist a need for 20 full-time junior high school science teacher, 10 quarter-time physics teachers and 10 quarter-time earth science/geology teachers in southern Illinois through 1985-86. Those projections also show there will be an adequate supply of general science and chemistry teachers, and an oversupply of biology teachers by that year.

The projections in Table 4 show essentially no demand for science teachers in southern Illinois by 1990-91. There are two possible explanations for this. First, it may be the principals actually did not anticipated a need to hire or release biology, chemistry, physcis, and/or earth science/geology teachers through 1990-91. Thus, the lack of projections for these areas in Table 4. Or, it may be the principals did not feel they could

anticipate science teacher demand through 1990-91. Given the principals were able to predict a stable school population through 1990-91, the low probability of all 32 principals not being able to anticipate science teacher demand, and the lack of any notes to this effect on the completed questionnaires, the author opts for the former explanation.

How do these levels of demand in Tables 3 and 4 compare to that for Illinois as a whole for those years? Rubba and Becker (1984) provide the following insights on statewide science teacher demand over the period.

> ISBE data (Naumer & Gill, 1983a) show 139 individuals completed science teacher training in Illinois during 1982-83 school year--83 in biology, 27 in chemistry, 3 in earth science, 2 in general science, 5 in physical science, 7 in physics, and 10 in other sciences--and 62 science teachers re-entered the science classroom (These numbers were the lowest in, at least, six years). Assuming science teacher production in Illinois levels off at the 1982-83 rate and that 50% of those completing science teacher training continue to take teaching positions (Shymansky & Aldridge, 1982, Figures 1 & 2), one can expect approximately 130 science teachers (140/2 + 60) will enter Illinois classrooms per year. That would mean between now and 1985-86 260 science teachers would enter Illinois classrooms, and by 1990-91 910 science teachers would do so.
>
> The 228 principals who returned questionnaires reported a need for 63 full-time (100%) science teachers by 1985-86...and 89 full-time science teachers by 1990-91.... When projected statewide (by multiplying by 7) the numbers rise to 441 and 623 full-time science teachers, respectively. The 441 full-time science teacher level of need for 1985-86 far out distances the 260 production estimate. When part-time postions and distributions across general science, biology, chemistry, etc. are taken into consideration, it would appear Illinois is facing a critical shortage of junior high school science, general science, chemistry, physics and earth science/geology teachers and a moderate shortage of biology teachers within the next two years. By the same reasoning, Illinois would appear to be facing critical shortages in junior high school science, high

school general science, and physics teachers, with a moderate shortage of chemistry teachers on to 1990-91. By that logic the data shows there will most probably be a moderate supply of chemistry teachers and an extreme oversupply of biology teachers.

It would appear from these discussions that science teacher demand will be far greater in other areas of Illinois than in southern Illinois through 1990-91. Hence, the author believes preservice science teachers with intentions of teaching in southern Illinois, especially those who intend to teach biology, need to be told the "facts of science teaching in Illinois" early in their college careers; they need to know science teacher demand will be greater in central and northern Illinois than in southern Illinois over the next decade, and counseled into physical science courses which will "qualify" them to teach general science (in grades 6 through 12), chemistry, or physics.

Table 1

Distribution of the 32 Southern Illinois Principals by ISBE Region

Region	Population #	Sample	Returns *	%
Alexander, Johnson, Massac, Pulaski, Union	24	6	2	33
Bond, Effingham, Fayette	25	6	3	30
Clay, Jasper, Richland	17	5	3	60
Clinton, Washington	18	4	1	25
Crawford, Lawrence	13	3	2	67
Edwards, Wabash, Wayne, White	23	6	3	50
Franklin	24	3	2	67
Gallatin, Hardin, Pope, Saline	16	4	2	50
Hamilaton, Jefferson	11	3	1	33
Jackson, Perry	22	6	3	50
Madison	29	8	1	13
Marion	13	3	1	33
Monroe, Randolph	16	4	2	50
St. Clair	46	12	4	33
Williamson	19	5	2	40

Column total = 316
* Column total = 32

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Table 2

Descriptive Statistics on School Populations
as Reported by the 32 Southern Illinois Principals

Statistic	1982-83	1985-86	1990-91
Mean	510.78	510.56	509.84
Median	425.00	442.50	432.50
Mode	250.00	500.00	300.00
Std. Deviation	326.80	318.32	309.30
Maximum	1500	1400	1500
Minimum	165	170	170

Table 3

Southern Illinois Full-time and Part-time Science Teacher Demand Through 1985-86

Area	Percentage of Full-time Position 25	50	75	100
Junior High School Science		0# (0)*		+2 (+20)
General Science				0 (0)
Biology	0 (0)			-3 (-30)
Chemistry	+1 (+10)	+1 (+10)		-2 (-20)
Physics	+1 (+10)			
Earth Science/Geology	+1 (+10)			

Net numbers provided by the 32 principals
* Projections for southern Illinois

Table 4

Southern Illinois Full-time and Part-time Science Teachers Demand Through 1990-91

Area	Percentage of Full-time Position 25	50	75	100
Junior High School Science		+1# (+10)*		-1 (-10)
General Science				0 (0)
Biology				
Chemistry				
Physics				
Earth Science/Geology				

Net numbers provided by 32 principals
* Projections for southern Illinois